



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.

Great Britain and Europe..... 4.50 a year.

Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

RELATIONS OF TEMPERATURE TO VERTEBRÆ  
AMONG FISHES.<sup>1</sup>

It has been known for many years that in certain groups of fishes the northern or cold-water representatives have a larger number of vertebræ than those members which are found in tropical regions. To this generalization, first formulated by Dr. Gill in 1863, we may add certain others which have been more or less fully appreciated by ichthyologists, but which for the most part have never received formal statement. In groups containing fresh-water and marine members, the fresh-water forms have in general more vertebræ than those found in the sea. The fishes inhabiting the depths of the sea have more vertebræ than their relatives living near the shore. In free-swimming pelagic fishes the number of vertebræ is also greater than in the related shore fishes of the same regions. The fishes of the earlier geological periods have for the most part numerous vertebræ, and those fishes with the low numbers (24 to 26) found in the specialized spiny-rayed fishes appear only in comparatively recent times. In the same connection we may also bear in mind the fact that those types of fishes (soft-rayed and anacanthine) which are properly characterized by increased numbers of vertebræ predominate in the fresh waters, the deep seas, and in Arctic and Antarctic regions. On the other hand, the spiny-rayed fishes are in the tropics largely in the majority.

In the present paper, I wish to consider the extent to which these statements are true and to suggest a line of explanation which covers all these generalizations alike.

For the purpose of this discussion we may assume the derivation of species by means of the various influences and processes, for which, without special analysis, we may use the term "natural selection." By the influence of natural selection, the spiny-rayed fish, so characteristic of the present geological era, has diverged from its soft-rayed ancestry.

The influences which have produced the spiny-rayed fish have been most active in the tropical seas. It is there that "natural selection" is most potent, so far as fishes are concerned. The influence of cold, darkness, monotony, and restriction is to limit the direct struggle for existence, and therefore to limit the resultant changes. In general the external conditions most favorable to fish life are to be found in the tropical seas, among rocks and along the coral reefs near the shore. Here is the centre of competition. From conditions otherwise favorable to be found in Arctic regions, the majority of competitors are excluded by their inability to bear the cold. In the tropics is found the greatest variety in surroundings, and therefore the greatest variety in the possible adjustments of series of individuals to correspond with these surroundings.

The struggle for existence in the tropics is a struggle between fish and fish, and among the individuals of a very great number of species, each one acquiring its own peculiar points of advantage. No form is excluded from competition. No competitor is handicapped by loss of strength on account of cold, darkness, foul water, or any condition adverse to fish life.

The influences which serve as a whole to make a fish more intensely and compactly a fish, and which tend to rid it of every character and every organ not needed in fish life, should be most effective along the rocks and shores of the tropics.

For this process of intensification of fish-like characters, which finds its culmination in certain specialized spiny-rayed fishes of the coral reefs, we may conveniently use the term "ichthyization."

If ichthyization is in some degree a result of conditions found in the tropics, we may expect to find a less degree of specialization in the restricted and often unfavorable conditions which prevail in the fresh waters, in the cold and exclusion of the polar seas, and especially in the monotony, darkness, and cold of the oceanic abysses where light can not penetrate and where the temperature scarcely rises above the freezing point.

An important factor in ichthyization is the reduction of the number of segments or vertebræ, and a proportionate increase in the size and complexity of the individual segment and its appendages. If the causes producing this change are still in operation, we should naturally expect that in cold water, deep water, dark water, fresh waters, and in the waters of a past geological epoch the process would be less complete and the numbers of vertebræ would be larger. And this, in a general way, is precisely what we find in the examination of a large series of fishes.

If this view is correct, we have a possible theory of the reduction in numbers of vertebræ as we approach the equator. It should, moreover, not surprise us to encounter various modifications and exceptions, for we know little of the habits and scarcely anything of the past history of great numbers of species. The present characters of species may depend on occurrences in the past concerning which even guesses are impossible.

It may be taken for granted that the ancestry of the various modern types of bony fishes is to be sought among the Ganoids. All the fossil forms in this group have a notably large number of vertebræ. The few now living are nearly all fresh-water fishes, and among these, so far as known, the numbers range from 65 to 110.

Among the *Teleostei* or bony fishes, those which first appear in geological history are the *Isospondyli*, the allies of

<sup>1</sup> Abstract of a paper by David Starr Jordan, president of Leland Stanford, Jr., University (Proceedings U.S. National Museum, XIV., 107).